What is claimed is:

1. A trap apparatus, installed in a vacuum exhaust system having a vacuum pump for vacuum exhausting a processing apparatus for performing a process on an object, for removing a gaseous impurity contained in an exhaust gas flowing through the vacuum exhaust system, the trap apparatus comprising:

an impurity collecting vessel installed in an exhaust passageway of the vacuum exhaust system; and

a nozzle unit for injecting an operation fluid to mix therewith the exhaust gas, and lowering an exhaust gas temperature down to or below a critical temperature of the impurity in the impurity collecting vessel, wherein the operation fluid is in a supersonic state by adiabatic expansion.

2. The trap apparatus of claim 1, further comprising one or more nozzle units provided in parallel with each other with respect to the impurity collecting vessel.

3. The trap apparatus of claim 1, wherein the nozzle unit includes a nozzle main body configured to have a flow path whose cross section becomes narrower along a flow direction of the operation fluid, and then, becomes wider after passing a larynx portion.

4. The trap apparatus of claim 3, wherein the nozzle main body has an operation fluid injection opening having a substantially circular cross section; and a ring shaped exhaust gas inlet opening is formed to surround a periphery of the operation fluid injection opening to thereby introduce the exhaust gas towards the impurity collecting vessel.

5. The trap apparatus of claim 3, wherein the nozzle main body has an operation fluid injection opening having a substantially ring shaped cross section; and, in a central portion thereof, there is formed a substantially circular exhaust gas inlet opening for introducing the exhaust gas towards the impurity collecting vessel.

6. The trap apparatus of claim 4, wherein there is provided a front end reservoir chamber for temporarily reserving the exhaust gas flowing towards the exhaust gas inlet opening.

7. The trap apparatus of claim 4, wherein, at a tip end side of the nozzle unit, there are provided a mixing tube for mixing the operation fluid in the supersonic state injected from the operation fluid injection opening and the exhaust gas introduced from the exhaust gas inlet opening; and a diffusion tube whose flow path cross section becomes

gradually broader to have a pumping function, wherein the mixing tube and the diffusion tube are connected in sequence.

8. The trap apparatus of claim 7, wherein the mixing tube and the diffusion tube are provided with an adhesion prevention heater unit for preventing the impurity from being attached thereto by being condensed and/or coagulated.

9. The trap apparatus of claim 1, wherein there is installed a nuclei introduction unit for introducing a substance to be used as nuclei when the gaseous impurity is condensed and/or coagulated.

10. The trap apparatus of claim 1, wherein, in the impurity collecting vessel, there is attachably and detachably installed an impurity adhesion plate for adhering thereon a condensed and/or coagulated impurities.

11. The trap apparatus of claim 1, wherein the nozzle unit is a Laval nozzle.

12. The trap apparatus of claim 1, wherein the operation fluid is formed of N_2, H_2, Ar or He gas.

13. The trap apparatus of claim 1, wherein the processing apparatus is a film forming apparatus for performing a film

formation on the object.

14. A processing system, comprising:

a processing apparatus for performing a process on an object;

a vacuum exhaust system having a vacuum pump for vacuum exhausting the processing apparatus; and

the trap apparatus of claim 1 installed in the vacuum exhaust system.

15. An impurity removal method for removing a gaseous impurity from an exhaust gas discharged from a processing apparatus which performs a process on an object, the method comprising the step of:

condensing and/or coagulating the impurity by mixing an operation fluid and the exhaust gas injecting the operation fluid into the exhaust gas, the operation fluid being in a supersonic state by adiabatic expansion; and lowering an exhaust gas temperature down to or below a critical point of the impurity.

16. The impurity removal method of claim 15, wherein the exhaust gas is injected to surround a periphery of the operation fluid when the exhaust gas and the operation fluid are mixed.

17. The impurity removal method of claim 15, wherein the operation fluid is injected to surround a periphery of the exhaust gas when the exhaust gas and the operation fluid are mixed.